FCC 97-370

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Part 25 of the	)	
Commission's Rules to Establish	)	IB Docket No. 96-220
Rules and Policies Pertaining	)	
to the Second Processing Round	)	
of the Non-Voice, Non-Geostationary	)	
Mobile Satellite Service	)	

REPORT AND ORDER

Adopted: October 8, 1997 Released: October 15, 1997

By the Commission:

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I. INTRODUCTION

1. By this Report and Order, we adopt rules and policies for the licensing and operation of satellite systems in the second processing round for the non-voice, non-geostationary ("NVNG") mobile-satellite service ("MSS"). Satellite systems providing this service, also referred to as "Little LEO service," use a constellation of low-Earth orbiting ("LEO") satellites to offer a variety of data communications services, including, but not limited to, remote meter reading, vehicle tracking and two-way data messaging services to customers anywhere in the world. The rules and policies we adopt in this Report and Order are designed to increase competition in the Little LEO service markets and to promote the rapid introduction of new and innovative Little LEO service offerings to the public.

2. Prior to adoption of this Report and Order, the five applicants remaining in the second processing round filed a joint proposal requesting that the Commission adopt a

mutually agreed upon spectrum sharing plan.[1] This Joint proposal would enable all five applicants to implement their system proposals and to avoid mutual exclusivity in the second processing round.[2] In this Report and Order, we adopt a spectrum sharing plan that is based upon the applicants' Joint Proposal. The spectrum sharing plan will permit the licensing of three new Little LEO satellite systems. These new Little LEO systems will increase competition in the Little LEO service markets which is likely to result in lower prices and increased service options for customers. Our spectrum sharing plan also provides additional spectrum for the two existing Little LEO licensees to implement their system modification requests. These modifications will enable existing Little LEO licensees to increase the service options available to their customers. Finally, we adopt in this Report and Order rules that establish a relaxed financial qualification standard on second processing round applicants, eligibility requirements for the use of future downlink spectrum allocated for the Little LEO service on a limited, priority basis by a second round applicant, and service rules to govern the licensing and operation of second processing round systems.

II. BACKGROUND

3. A Little LEO satellite system allows customers to use small, inexpensive, mobile user terminals to send and receive short data messages anywhere in the world.[3] A Little LEO satellite system is comprised of mobile user terminals and gateway earth stations that communicate with a constellation of LEO satellites. A network control center on earth manages the system operations. A user can send or receive a data message utilizing a mobile user terminal that, in turn, communicates with a LEO satellite via low power subscriber or service links. Gateways form the hub of the system and continuously exchange data messages with LEO satellites via high power feeder links. LEO satellites transmit data messages received directly to mobile user terminals on earth or indirectly through gateways for routing to users connected to the public switched network. A constellation of Little LEO satellites is capable of providing remote meter reading, position location, emergency location, security alerts, vehicle tracking and monitoring, environmental data collection, and other time-sensitive business and personal data communications.

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[1] Five of the applicants submitted a spectrum sharing plan to the Commission. See Joint Proposal, dated September 19, 1997, among E-SAT, Inc., Final Analysis Communication Services, Inc., Leo One USA Corporation, Orbital Communications Corporation, Orbital Sciences Corporation and Volunteers in Technical Assistance, IB Docket No. 96-220 (the "Joint Proposal").

[2] Initially there were eight applicants in the second processing round. Prior to the adoption of this Report and Order, two applicants (Starsys Global Positioning, Inc. and GE American Communications, Inc.) withdrew their second processing round applications. The Joint Proposal provides that a third applicant (CTA Commercial Systems, Inc.) will withdraw its application from the second processing round. Consistent with the Joint Proposal, five applicants will remain eligible for second processing round licenses. See, infra, ¶ 10.

[3] In order to provide global service, a Little LEO service provider will need to receive authorization or approval from each country in which it intends to offer Little LEO service.

4. The licensing process for Little LEO systems began in 1990 when Orbital Communications Corporation ("Orbcomm") filed an application proposing a commercial Little LEO system. Thereafter, Starsys Global Positioning, Inc. ("Starsys") and Volunteers in Technical Assistance, Inc. ("VITA")[4] filed applications to be considered concurrently with that of Orbcomm's. These applicants, comprising the first Little LEO processing round, requested authority to operate their systems, both service and feeder links, in a variety of frequency bands below 1 GHz, specifically, in the 148-149.9 MHz, 137-138 MHz, and 400.15-401 MHz frequency bands. At that time, these frequency bands were not allocated worldwide or domestically to the Little LEO service.

5. At the 1992 World Administrative Radio Conference ("WARC-92"), these bands, in addition to the 149.9-150.05 MHz band, were allocated to the Little LEO service on a worldwide primary shared basis.[5] WARC-92 also adopted a new frequency coordination procedure for Little LEO services. Consequently, Little LEO operations must be coordinated with the operations of other primary services in these bands.

6. In 1993, we allocated the WARC-92 bands domestically to the Little LEO service on a primary shared basis[6] and adopted rules and policies for licensing applicants in the first processing round.[7] These rules and policies were largely drawn from a successful negotiated rulemaking proceeding,[8] where the applicants agreed to a framework that would allow all three systems to operate in the available spectrum. The applicants represented in the Negotiated Rulemaking Report that their agreement would also allow us to license additional

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[4] VITA's request for experimental authorization on September 7, 1988, which the Commission later granted, was the first request for authorization to provide Little LEO service. See Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum for Fixed and Mobile Satellite Services for Low-Earth Orbit Satellites, Report and Order, 8 FCC Rcd 1812 (1993).

[5] World Administrative Radio Conference 1992, Torremolinos, Spain. "Primary" services have equal rights to operate in particular frequencies. A station providing a primary service is protected against interference from a station providing a "secondary" service. A station providing a secondary service cannot claim protection from harmful interference from a station providing a primary service. See 47 C.F.R. §§ 2.104(d) and 2.105(c). The 149.9-150.5 MHz band is allocated for land MSS, not aeronautical or maritime MSS use.

[6] Amendment of Section 2.106 of the Commission's Rules to allocate Spectrum to the Fixed Satellite Service and the Mobile Satellite Service for Low-Earth Orbiting Satellites, Report and Order, 8 FCC Rcd 1812 (1993).

[7] Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Non-Voice, Non-Geostationary Mobile Satellite Service, Report and Order, 8 FCC Rcd 8450 (1993) ("Little LEO Order").

[8] Report of the Below 1 GHz LEO Negotiated Rulemaking Committee, September 16, 1992 ("Negotiated Rulemaking Report").

systems in these bands.[9] By the end of 1995, we issued licenses to all three first round applicants.[10]

7. LEO One USA Corporation ("LEO One") filed an application for a new Little LEO system and in September, 1994, we placed LEO One's application on public notice.[11] In the Public Notice, we established a cut-off date for filing applications to be considered concurrently with LEO One's application. In response, four entities filed applications for new Little LEO systems: CTA Commercial Systems, Inc. ("CTA"), E-Sat, Inc. ("E-Sat"), Final Analysis Communication Services, Inc. ("Final Analysis"), and GE American Communications, Inc. ("GE Americom"). Two first round licensees, VITA and Orbcomm, filed modifications to their licensed systems to use additional frequency bands within the WARC-92 allocation.[12] These modifications were treated as part of the second processing round. In addition, Starsys (hereinafter referred to as "GE-Starsys")[13] filed an amendment on April 25, 1994, after the cut-off date for filing applications in the first processing round, proposing use of additional frequency bands in the WARC-92 allocations. We found this filing to be a "major amendment" and deferred its consideration to the second processing round.[14] Consequently, all three first round Little LEO licensees became applicants in the second processing round. Thus, initially there were a total of eight applicants in the second processing round.

8. At the 1995 World Radio Conference ("WRC-95"), additional uplink spectrum was allocated for the Little LEO service. The WRC-95 spectrum consists of the 399.9-400.05 MHz, 455-456 MHz, and 459-460 MHz frequency bands. The 399.9-400.05 MHz frequency

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[9] Id. at 8-9; Little LEO Order ¶ 21 and n.38.

[10] Application of Orbcomm for Authority to Construct, Launch, and Operate a Non-Voice, Non-Geostationary Mobile-Satellite System, Order and Authorization, 9 FCC Rcd 6476 (1994) ("Orbcomm Authorization") recon. 10 FCC Rcd 7801 (1995); Application of Starsys for Authority to Construct, Launch, and Operate a Non-Voice, Non-Geostationary Mobile-Satellite System, Order and Authorization, 11 FCC Rcd 1237 (1995) ("Starsys Authorization"); Application of VITA for Authority to Construct, Launch, and Operate a Non-Voice Non-Geostationary Mobile-Satellite System, Order and Authorization, 11 FCC Rcd 1358 (1995) ("VITA Authorization").

[11] We placed LEO One's application on public notice on September 16, 1994 prior to granting the first Little LEO license on October 20, 1994, the second on July 21, 1995, and the third on November 13, 1995. See Satellite Application Acceptable for Filing Cut-off Established for Additional Applications, Public Notice Report No. DS-1459 (September 16, 1994) ("Public Notice").

[12] Non-Voice Non-Geostationary Low Earth Orbit Satellite Applications Accepted for Filing, Public Notice Report No. DS-1484 (November 25, 1994).

[13] GE American Communications, Inc. subsequently acquired an 80 percent equity interest in Starsys Global Positioning, Inc.

[14] See GE-Starsys Authorization ¶¶ 19, 21.

band is allocated worldwide and domestically for land MSS use.[15] The 455-456 MHz and the 459-460 MHz frequency bands are allocated for MSS use in International Telecommunication Union ("ITU") Region 2 only and are proposed to be allocated domestically for MSS use in a pending Commission proceeding.[16]

9. In October, 1996, we issued a Notice of Proposed Rulemaking (the "Notice")[17] proposing service rules to select licensees from among the applicants in the second processing round. In the Notice we proposed to: (1) limit eligibility in the second processing round to applicants who are not already Little LEO licensees or their affiliates; (2) restrict a second round licensee from transferring its license to an existing Little LEO licensee or its affiliate for a five-year period; (3) adopt a strict financial qualification standard for second round applicants; (4) license up to three new Little LEO systems; (5) conduct an auction to select licensees if there were more qualified applicants than available spectrum; (6) require that systems be equipped with position determination equipment; and (7) prohibit exclusive agreements between Little LEO licensees and foreign countries. In addition, we solicited comments regarding establishing a priority for second round licensees to use WRC-95 and WRC-97 spectrum for their licensed systems. In response to the Notice, each of the existing Little LEO licensees objected to our proposal to exclude their participation in the second processing round. Generally, commenters expressed both support and opposition for each of our proposals, with two exceptions. Commenters were unanimous in their opposition to auctions and a requirement that Little LEO mobile user terminals be equipped with position determination devices.

10. Since our release of the Notice, GE-Starsys returned its first round authorization to the Commission[18] and withdrew its second round application.[19] Similarly, GE Americom

[15] International Telecommunication Union, Final Acts of the World Radiocommunication Conference, Art. S5 at 119 (1995); 47 C.F.R. § 2.106; Footnotes US319, US326.

[16] See Amendment of Part 2 of the Commission's Rules to Allocate the 455-456 MHz, and 459-460 MHz bands to the Mobile-Satellite Service, Notice of Proposed Rulemaking, ET Docket No. 97-214, FCC 97-363 (rel. October 14, 1997). ITU Region 2 encompasses the countries in the northern hemisphere and Greenland.

[17] Amendment of Part 25 of the Commission's Rules to Establish Rules and Policies Pertaining to the Second Processing Round of the Non-Voice Non-Geostationary Mobile Satellite Service, Notice Of Proposed Rulemaking, IB Docket No. 96-220, FCC 96-426 (released October 29, 1996).

[18] See Letter dated August 4, 1997, from John DiMarco, President, Starsys Global Positioning, Inc., to William F. Caton, Acting Secretary, Federal Communications Commission ("GE-Starsys Letter").

[19] See Letter dated August 25, 1997, from Peter A. Rohrbach, Counsel for Starsys Global Positioning, Inc., to Thomas S. Tycz, Chief, Satellite and Radiocommunication Division, International Bureau, Federal Communications Commission.

withdrew its second round application.[20] Orbcomm's parent corporation, Orbital Sciences Corporation, acquired certain of the assets of CTA Incorporated, parent of CTA, including the stock of CTA under a separate agreement between Orbital Sciences Corporation and CTA Incorporated.[21] The Joint Proposal specifies that under that agreement Orbital Sciences Corporation has agreed to cause the withdrawal of CTA's second round application. Subsequent to these events, the applicants, over the course of a series of discussions, developed a spectrum sharing plan that culminated in the filing of the Joint Proposal that proposes to accommodate all of the second round applicants. [22]

III. DISCUSSION

11. A primary Commission objective is to create a regulatory environment that fosters the provision of efficient, innovative, and cost-effective NVNG MSS communications services in the United States.[23] To accomplish this objective, our satellite service rules (1) encourage entry by qualified applicants, (2) discourage "warehousing" of orbit-spectrum resources by those who will not use it or who are under-financed and (3) provide operators with maximum

[20] See Letter dated August 25, 1997, from Philip V. Otero, Senior Vice President and General Counsel, GE American Communications, Inc., to William F. Caton, Acting Secretary, Federal Communications Commission.

[21] See Letter dated August 14, 1997, from Phillip L. Spector, Attorney for CTA Commercial Systems, Inc., to William Caton, Acting Secretary, Federal Communications Commission ("CTA Letter"); Letter dated August 19, 1997, from Stephen L. Goodman, Counsel for Orbcomm, to Peter Cowhey, Chief, International Bureau, Federal Communications Commission ("Orbcomm Letter"). According to the Orbcomm Letter, Orbital Sciences possesses certain contractual rights that enable it to cause the withdrawal of CTA's second round application. These rights arise from that certain Agreement Regarding FCC Application, dated August 14, 1997, between Orbital Sciences Corporation and CTA Incorporated. See CTA Letter at Appendix B. CTA has filed an amendment to its second round application indicating that it is assigning the application to CTA Incorporated. Id.

[22] See Joint Proposal; see also Orbcomm Letter; Letter dated August 15, 1997, from Robert A. Mazer, Albert Shuldiner, Counsel for LEO One USA Corporation, to Peter Cowhey, Chief, International Bureau, Federal Communications Commission ("LEO One Letter"); Memorandum dated August 22, 1997, from Fred W. Thompson, President, E-Sat, to Cassandra Thomas, International Bureau, Federal Communications Commission ("E-Sat Letter"); Letter dated August 28, 1997, from Aileen A. Pisciotta and Peter A. Batacan, Counsel to Final Analysis Communications Services, Inc., to Peter Cowhey, Chief, International Bureau, Federal Communications Commission ("Final Analysis Letter"); and Letter dated August 28, 1997, from Joseph A. Godles, Attorney for Volunteers in Technical Assistance, to William F. Caton, Acting Secretary, Federal Communications Commission ("VITA Letter").

[23] See 47 U.S.C. § 151.

flexibility to tailor their offerings to meet their customers' requirements.[24] This "Open Skies" policy has enabled the United States to lead the world in developing and implementing satellite technology. In this second Little LEO processing round, our objective is to foster an environment that promotes competition through new entry and produces new and innovative service offerings in the Little LEO service markets for the benefit of the United States public. Accordingly, after review of the comments and other information filed in response to our Notice, we adopt a spectrum sharing plan that permits licensing three new Little LEO systems and two existing Little LEO licensees in WARC-92 spectrum, a relaxed financial qualification standard for applicants, a rule establishing eligibility requirements for a second processing round licensee to use a limited amount of future downlink spectrum allocated to the Little LEO service, and service rules to govern the licensing and operation of second round systems. We do not adopt auction rules because our spectrum sharing plan avoids mutual exclusivity among applicants. We also do not impose a position determination requirement for Little LEO user terminals. Finally, we prohibit Little LEO licensees from entering exclusive service agreements with foreign countries.

A. Second Round Licensing Procedures.

1. New Entrant Requirement

12. In the Notice, we proposed a new entrant policy that would exclude existing Little LEO licensees and their affiliates from participation in the second processing round.[25] The purpose of the new entrant requirement is to promote competition and multiple entry of new entrants in the emerging Little LEO service markets.[26] The existing Little LEO licensees and Iridium, a Big LEO system,[27] oppose the adoption of such a rule on various grounds.[28] New

[24] See, e.g., Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Band, 9 FCC Rcd 5936 (1994) ("Big LEO Order"); Policies and Procedures for Licensing of Space and Earth Stations in the Radiodetermination Satellite Service, 104 FCC 2d 650 (1986) ("RDSS Order").

[25] See Notice ¶ 11.

[26] Id.

[27] A "Big LEO system" is a commercial LEO satellite network capable of providing both voice and data MSS on a global basis that operates in the frequency bands above 1 GHz. Big LEO systems are capable of providing many of the same services that Little LEO satellite systems will be able to offer to users.

[28] See Comments of Orbcomm at 9, 15-16 and Comments of GE-Starsys at 3 (contending that the new entrant proposal constituted unlawful retroactive rulemaking and did not provide sufficient notice to existing Little LEO licensees); Comments of VITA; and Comments of Iridium at 2-4 (new entrant policy might limit investment in U.S. satellite systems, is not necessary to promote competition and may prevent U.S. systems from being truly competitive).

applicants CTA, E-Sat, Final Analysis, and LEO One generally support our adoption of the new entrant proposal.[29]

13. After we released our Notice, several events have occurred which, taken as a whole, have caused us to reassess the proposal in our Notice. Specifically, GE-Starsys returned its first round license and withdrew its second round application. Similarly, GE Americom withdrew its second round application. In addition, Orbital Sciences Corporation has acquired CTA's satellite division and agreed to cause the withdrawal of CTA's pending second round application. These events have resulted in additional spectrum becoming available for use by the remaining second round applicants. Moreover, sufficient spectrum is available to permit first round licensees, Orbcomm and VITA, to increase the size of their existing systems without reducing the entry opportunities for the new entrants applying in the second round. Under these circumstances, allowing Orbcomm and VITA to participate in the second processing round is unlikely to impede new entrants into the Little LEO service markets. To the contrary, it is more likely to enhance competition in all Little LEO service markets. Consequently, we do not adopt our new entrant proposal in this Report and Order because it is not necessary to promote competition and entry opportunities for new Little LEO systems in the emerging Little LEO service markets.

14. Since the release of our Notice, the second processing round applicants have mutually agreed upon a spectrum sharing plan that accommodates all remaining second round applicants in the available spectrum. The spectrum sharing plan agreed to by the second round applicants forms the basis for the spectrum sharing plan that we adopt in this Report and Order. In proceedings, such as this one, in which more applicants apply for spectrum than the available spectrum can accommodate, the Commission encourages applicants to work together to develop a spectrum sharing plan that accommodates all of the applicants, including new entrants. This approach is likely to promote competition and result in a more efficient use of the available spectrum for a particular service than if the Commission is required to choose which applicants will operate in the spectrum being licensed. Our concern about existing Little LEO licensees obtaining additional spectrum in the second processing round to the exclusion of potential new entrants has been alleviated by the spectrum sharing plan that we adopt in this Report and Order that accommodates all second round applicants.

2. Holding Period

15. In the Notice, we proposed prohibiting a second round Little LEO licensee from transferring or assigning its license to an existing Little LEO licensee or its affiliate for a period of five years.[30] This rule would apply whether or not the license is awarded through Commission decision, settlement, auctions, or some other licensing selection mechanism. This

[29] See Comments of CTA at 2; Comments of E-Sat at 16-17; Comments of Final Analysis at 4; LEO One at 5-6.

[30] Notice ¶ 18.

proposal reflected our concern that allowing existing Little LEO licensees or their affiliates to obtain a second round license soon after its grant would undercut our new entrant proposal designed to promote competition in the Little LEO service markets through the entry of new competitors. LEO One agrees that competition would be adversely affected if a second round license could be transferred or assigned to a first round licensee.[31]

16. We decline to adopt the holding period proposal in our Notice. Because we are not adopting our new entrant proposal, the holding period proposal, which was designed to prevent applicants from circumventing the proposed new entrant rule is no longer necessary. Accordingly, we will not impose a rule that, as a general matter, will restrict the transfer or assignment of a second round Little LEO license to an existing Little LEO licensee.

17. We will, however, review requests to transfer or assign second round Little LEO licenses on a case-by-case basis to determine whether such disposition is in the public interest.[32] Under this public interest analysis, we will review these requests to ensure that their grant would be consistent with our goals of promoting competition and opportunities for new entry in the Little LEO service markets. In doing so, we will have the flexibility to consider different competitive configurations in the future if warranted by then-prevailing market conditions.[33]

3. Financial Qualifications

18. Under our existing rules, a Little LEO applicant must demonstrate that it has the finances necessary to construct, launch and operate two satellites in its system for at least one year ("relaxed financial standard").[34] However, in the Notice, we proposed that an applicant in the second processing round demonstrate that it has the finances necessary to construct, launch and operate its entire system for one year ("strict financial standard").[35] Because our spectrum sharing plan can accommodate all of the second processing round applicants in the available spectrum, we find it unnecessary to require a second round applicant to meet the strict financial standard. Therefore, we will retain our relaxed financial standard to determine a second round applicant's financial qualification for a license.

[31] Comments of LEO One at 23.

[32] 47 C.F.R. § 25.118.

[33] See DBS Order, In the Matter of Revision of Rules and Policies for the Direct Broadcast Satellite Service, FCC 95-507, IB Docket No. 95-168, PP Docket No. 93-253, ¶ 55 (1995).

[34] Id. § 25.142 (a)(4).

[35] See Notice ¶ 40.

19. GE-Starsys, LEO One, and Orbcomm support the adoption of the strict financial standard, while Final Analysis and CTA oppose it.[36] CTA argues that a strict financial standard would impede competition and it would be unfair to impose a standard stricter than that applied to the applicants in the first processing round.[37] In addition, CTA asserts that adopting a strict financial standard is unnecessary because application of our new entrant proposal will enable us to accommodate all remaining second round applicants in the available spectrum.[38] Final Analysis contends that the system would be commercially viable before it is fully implemented, and therefore, a strict standard is not necessary.[39]

20. Adoption of a relaxed financial standard is consistent with the approach used in the first Little LEO processing round where we could accommodate all of the applicants in the available spectrum.[40] Similarly, the spectrum sharing plan we adopt in this Report and Order will accommodate all second round applicants within the spectrum available in the second processing round. This is also consistent with our financial requirements for other satellite services where we have tailored the financial requirements on the basis of entry opportunities in a particular service.[41] Thus, we will apply the relaxed financial standard to second round applicants and will not adopt our proposal to apply a strict financial standard.

4. Use of WRC-95 and WRC-97 Spectrum

21. In the Notice, we requested comment on how we should use the WRC-95 spectrum and any spectrum allocated for Little LEO service at WRC-97.[42] Some commenters suggest that we allow first and second round Little LEO licensees to use WRC-95 spectrum to meet their second round application requirements.[43] Others urge us to provide first and second round Little LEO licensees with priority to use WRC-95 and WRC-97 spectrum before

[36] Comments of CTA at 16; Comments of Final Analysis at 42 ; Comments of GE-Starsys at 26; Comments of LEO One at 38; Comments of Orbcomm at 34.

[37] Comments of CTA at 16.

[38] Id.

[39] Comments of Final Analysis at 42.

[40] 47 C.F.R. § 25.142(a)(4).

[41] See e.g., RDSS Order.

[42] Notice ¶ 78.

[43] Comments of Final Analysis at 29-30; Comments of Orbcomm at 45; and Comments of E-Sat at 14.

any other applicant.[44] As explained below, we decline to assign the WRC-95 uplink spectrum for use by second round Little LEO licensees in this Report and Order. However, we find it to be in the public interest to establish requirements pursuant to which a second processing round licensee will be eligible to use a limited amount of WRC-97 and/or future downlink spectrum allocations for the Little LEO service to the extent necessary to implement its Little LEO system as applied for in the second processing round.[45]

22. At WRC-95, uplink spectrum was allocated for the Little LEO service, specifically, the 399.9-400.05 MHz (worldwide use), 455-456 MHz, and 459-460 MHz frequency bands (Region 2 use only). We have allocated the 399.9-400.05 MHz band for domestic use and have proposed domestically allocating the 455-456 MHz and 459-460 MHz bands for this service. The Joint Proposal does not contemplate use of the 399.90-400.05 MHz band by any of the applicants to implement their systems.[46] Therefore, we will not include use of this spectrum in the spectrum sharing plan we adopt in this Report and Order. Most of the pending applicants do, however, request that we assign the WRC-95 455-456 MHz and 459-460 MHz frequency bands to second round licensees for uplink operations.[47] However, as previously noted, these bands have been proposed to be domestically allocated for the Little LEO service. If the bands are domestically allocated for the Little LEO service, the second round applicants may request that the Commission make this spectrum available for use by first and second round Little LEO licensees.

23. Commenters from the petroleum and oil spill industry expressed concern that domestic allocation of the 459-460 MHz frequency band for Little LEO service will adversely impact their ability to support oil spill containment and clean-up activities.[48] A 25 kHz channel in the 459-460 MHz frequency band is currently allocated to the petroleum radio service and is dedicated on a primary basis for communications related to oil spill containment and clean up activities. This concern is beyond the scope of this proceeding. More appropriately, it should be addressed separately in the Commission's rulemaking proceeding commenced to domestically allocate the 455-456 MHz and the 459-460 MHz frequency bands for NVNG MSS service.

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[44] Comments of CTA at 7, 27; Comments of E-Sat at 14; Comments of Final Analysis at 29-32; Comments of GE-Starsys at 13; Comments of LEO One at 38. See also Final Analysis Letter.

[45] See, infra, ¶¶ 35-37.

[46] See Joint Proposal.

[47] Id. at 9. These uplink bands are allocated on a worldwide, co-primary basis to the Little LEO service.

[48] See Comments of American Petroleum Institute; Comments of Clean Casco Bay, Inc.; Comments of Industrial Telecommunications Association, Inc.; Comments of Texas General Land Office.

24. The Association of American Railroads and Affiliated American Railroads urge us to use caution in assigning the WRC-95 and WRC-97 spectrum.[49] They ask that the Commission not consider use of such spectrum until there has been a demonstration through proper studies that such transmissions will not cause interference to land mobile communications.[50] As discussed below, the spectrum sharing plan that we adopt in this Report and Order does not assign WRC-95 spectrum for use by the second round applicants, however, it does establish a first priority for one second round licensee to utilize a limited amount of WRC-97 or future downlink spectrum allocated by the ITU to the NVNG MSS service. Any spectrum allocated to the NVNG MSS service in the future by the ITU still will be required to be domestically allocated by the Commission. As with all domestic allocations of spectrum for satellite service, we will commence the necessary proceedings to ensure that spectrum will be used consistent with the public interest and in a manner that avoids harmful interference to other authorized users. The domestic allocation process and service rules governing the use of any spectrum are sufficient to ensure interference-free operations between satellite and land mobile services. We encourage both satellite and land mobile service providers to work together to resolve any sharing issues that may arise.

B. Spectrum Sharing Plan

1. Overview

25. Upon review of the comments, the Joint Proposal, and our own technical analysis, we conclude that with appropriate transmission techniques, proper system coordination, and time-sharing of frequencies, there is sufficient spectrum available in the second processing round to issue five Little LEO service licenses: three licenses to second round applicants not previously authorized by the Commission to provide Little LEO service and two licenses to existing Little LEO licensees for modifications to their systems. We will use the WARC-92, WRC-97 and future downlink spectrum allocated worldwide and domestically to the Little LEO service to license second round applicants.[51] Our Notice proposed licensing up to three Little LEO systems.[52] However, in light of recent events, including, but not limited to, GE-Starsys's return of its first round authorization to the Commission, Orbital Sciences Corporation's agreement to acquire second round applicant CTA and withdraw CTA's application from the second processing round, and the filing of the Joint Proposal evidencing the applicants' mutual agreement upon a spectrum sharing plan, we conclude that sufficient

[49] Comments of Affiliated American Railroads; Comments of the Association of American Railroads.

[50] Reply Comments of Affiliated American Railroads; Comments of the Association of American Railroads.

[51] The WARC-92 spectrum includes the 148-150.05 MHz, 400.15-401 MHz and 137-138 MHz frequency bands.

[52] See Notice ¶ 42.

spectrum now exists to accommodate the remaining applicants in the Little LEO second processing round.[53]

26. We remind the applicants that this Report and Order adopts a licensing scheme and service rules that will be applicable to second processing round Little LEO licensees. The spectrum sharing plan adopted herein does not assure that a second round applicant will be licensed to operate its system in the spectrum it is designated to operate in pursuant to this Report and Order. We will make licensing determinations after evaluating the technical and financial qualifications of the applicants that file an amendment to their second processing round applications to conform to the rules and policies adopted in this Report and Order.[54]

27. We will use the WARC-92 spectrum available for Little LEO service in the 148-150.05 MHz uplink band and the 137-138 MHz and 400.15-401 MHz downlink bands. When we established the second processing round, we invited applications for service in these frequency bands and in the Notice we proposed licensing systems in the WARC-92 frequency bands.[55] In their first round sharing plan, Orbcomm, GE-Starsys, and VITA agreed that additional systems could be accommodated in these bands by using frequency division multiple access ("FDMA") and code division multiple access ("CDMA") transmission techniques.[56] In the Notice, we sought comment on the use of WRC-95 spectrum by applicants in the second processing round.[57] However, none of the applicants expresses an interest in operating its system in the WRC-95 399.9-400.05 MHz band. As previously discussed, the 455-456 MHz and 459-460 MHz bands have been proposed to be domestically allocated for the Little LEO service in a pending Commission rulemaking proceeding. Consequently, we will not include any WRC-95 spectrum in the spectrum sharing plan we adopt for the second processing round.

a. System 1

28. One new Little LEO applicant can operate a system ("System 1") in the 148-150.05 MHz (uplink) band and the 137-137.025 MHz. 400.15-400.505 MHz and 400.645-401 MHz (downlink) bands. The spectrum will be used most efficiently if System 1 utilizes

[53] See, infra, ¶ 10.

[54] This Report and Order requires that second round applicants must file an amended application to apply for a second round license. See ¶¶ 129-132.

[55] See Public Notice; see also Notice ¶¶ 41-42.

[56] See Negotiated Rulemaking Report at 8-9.

[57] See Notice ¶ 78.

FDMA/TDMA transmission techniques. The second round applicants and LEO One agreed in the Joint Proposal that LEO One will operate as System 1.[58]

29. In the uplink bands, System 1 will share approximately 355 kHz of spectrum in the 148-148.855 MHz band with System 2, System 3 and Orbcomm, subject to coordination with the French S80-1 system. System 1 will preserve approximately 500 kHz of contiguous spectrum in the 148-148.855 MHz band that will not be shared by System 1, System 2 or Orbcomm for use by System 3 and the S80-1 system. System 1 may also share the 148.855-148.905 MHz band with System 2 and Orbcomm if System 3 does not use this band for feeder links. Subject to S80-1's use of the 148.905-148.955 MHz band for feeder links, System 1 will share the 148.905-149.81 MHz band with System 2 and first round licensee Orbcomm, provided, that Orbcomm shall have exclusive use of the 149.585-149.635 MHz portion of the band for feeder link use until it relocates its feeder uplink to the 150-150.05 MHz band. System 1 shall operate its feeder uplinks in the 149.95-150 MHz band subject to coordination with the Russian Radio Navigation Satellite Service ("RNSS") system.

30. In the downlink bands, a System 1 licensee shall have the right to operate in the 400.15-400.505 MHz and 400.645-401 MHz bands on a time-shared basis with the Department of Defense ("DoD") Defense Meteorological Satellite Program ("DMSP") system. Upon request to the Commission, System 1 shall be permitted to operate in the 400.505-400.5517 MHz, 400.5517-400.5983 MHz, and/or the 400.5983-400.645 MHz bands outside of a processing round upon System 2's surrender of its authorization, notification to the Commission that it is discontinuing its use of these bands or the Commission's revocation of System 2's authorization, subject to the same conditions imposed upon System 2's operations in these bands (including, but not limited to, permission from the Government of France to operate in the 400.5517-400.5983 MHz band and time-sharing with VITA in the adjacent bands). System 1's use of the 137-137.025 MHz band must be coordinated with France's S80-1 system and on a non-interference basis to adjacent bands. System 1 shall notify the Commission within 30 days of discontinuing its use of the 137-137.025 MHz band.

b. System 2

31. A second new Little LEO applicant can operate a system ("System 2") in the 148-150.05 MHz (uplink) and the 400.15-401 MHz and 137-138 MHz (downlink) bands.[59] The spectrum available to System 2 will be used most efficiently if System 2 utilizes

[58] See Joint Proposal at 2.

[59] The spectrum available to System 2 in the 137-138 MHz band includes: 137.025-137.175 MHz, 137.333-137.4125 MHz, 137.475-137.525 MHz, 137.595-137.6450 MHz, 137.753-137.787 MHz, 137.825-138 MHz and 137-137.025 MHz band, subject to the conditions set forth in this Report and Order.

FDMA/TDMA transmission techniques. The second round applicants and Final Analysis agreed in the Joint Proposal that Final Analysis will operate as System 2.[60]

32. In the uplink bands, System 2 will share approximately 355 kHz of spectrum in the 148-148.855 MHz band with System 1, System 3 and Orbcomm, subject to coordination with the S80-1 system. System 2 will preserve approximately 500 kHz of contiguous spectrum in the 148-148.855 MHz band that will not be shared by System 1, System 2 or Orbcomm for use by System 3 and the S80-1 system. If System 3 does not use the 148.855-148.905 MHz band for feeder links, System 2 may share this band with System 1 and Orbcomm. Subject to S80-1's use of the 148.905-148.955 MHz band for feeder links, System 2 will share the 148.905-149.81 MHz band with System 1 and first round licensee Orbcomm, provided, that Orbcomm shall have exclusive use of the 149.585-149.635 MHz portion of the band for feeder link use until it relocates its feeder uplink to the 150-150.05 MHz band. System 2 shall operate its feeder links in the 150-150.05 MHz band, subject to coordination with the Russian RNSS system. However, if System 2 is authorized to relocate its feeder uplinks to spectrum allocated to the Little LEO service at WRC-97 or a future World Radiocommunication Conference and domestically by the Commission, System 2 shall vacate the 150-150.05 MHz band and Orbcomm shall relocate its feeder uplinks from the 149.585-149.635 MHz band to the 150-150.05 MHz band.

33. In the 400.15-401 MHz downlink band, upon a written request from System 2, the Commission will initiate a communication to the Government of France requesting permission for System 2 to operate in the 400.5517-400.5983 MHz band, previously coordinated for use by the S80-1 system, until the S80-1 system commences operations in this spectrum. System 2 shall operate in the 400.505-400.5517 MHz band subject to time-sharing this spectrum with VITA's satellite authorized in the first processing round. Likewise, System 2 shall operate in the 400.5983-400.645 MHz band subject to time-sharing this spectrum with the VITA satellite applied for in the second processing round if VITA receives authorization from the Commission to construct, launch and operate this satellite. System 2 shall notify the Commission in writing within 30 days of discontinuing its use of any portion of the 400.505-400.645 MHz band.

34. In the 137-138 MHz downlink band, System 2 will time-share with the National Oceanic and Atmospheric Administration ("NOAA") use of the 137.333-137.367 MHz, 137.475-137.525 MHz, 137.595-137.645 MHz and 137.753-137.787 MHz (the "NOAA channels") consistent with NOAA's implementation of the NOAA channels and 137.025-137.175 MHz and 137.825-138 MHz (the "NOAA bands"). System 2 will time-share use of the 137.375-137.4125 MHz band subject to coordination with the Russian METEOR system. System 2's use of the 137-138 MHz band must be coordinated with System 3, consistent with the agreements GE-Starsys entered into with NOAA and the S80-1 system and with Orbcomm with respect to sharing adjacent channels. Finally, upon request to the Commission, System 2

[60] See Joint Proposal at 2.

will be permitted to operate in the 137-137.025 MHz band outside of a processing round upon System 1's surrender of its authorization, notification to the Commission that it is discontinuing its use of these bands or the Commission's revocation of System 1's authorization, subject to the same conditions imposed upon System 1's operations in these bands by the Commission or through coordinations with other authorized users.

35. In addition, System 2 shall have a first priority to apply for a limited amount of downlink spectrum allocated to the Little LEO service. Some of the commenters suggest that we grant first and second round Little LEO licensees priority to use future spectrum allocations for the Little LEO service.[61] Final Analysis contends that, without the use of additional spectrum, System 2 under the proposed spectrum sharing plan lacks sufficient service downlink spectrum to implement a large Little LEO system capable of providing intermittent to near real-time Little LEO services.[62] All the second round applicants have agreed that System 2 should have access to future spectrum to implement its system.[63] A significant portion of the spectrum assigned to System 2 in the 137-138 MHz band is allocated on a secondary basis to the Little LEO service and must be shared on a non-interference basis with United States government and foreign satellite systems operating primary services in such spectrum.[64] Thus, this spectrum may be unavailable or of limited use to System 2 for service downlinks thereby threatening System 2's commercial viability and competition among service providers in the Little LEO service markets.[65] Making available a limited amount of future downlink spectrum allocated for the Little LEO service solely to System 2 for the purpose of completing the implementation of its second round system is likely to result in three large systems capable of providing a wide range of Little LEO services. More large systems providing a wide array of Little LEO services promotes

[61] Comments of LEO One at 38; Comments of Final Analysis at 29 and Final Analysis Letter; and Comments of E-Sat at 16.

[62] See Final Analysis Letter.

[63] See Joint Proposal.

[64] The NOAA bands assigned to System 2 under our spectrum sharing plan consist of approximately 325 kHz of spectrum allocated to the Little LEO service on a secondary, non-interference basis to space operation service, meteorological satellite service and space research service systems. 47 C.F.R. § 2.106; Table of Frequency Allocations. In addition to United States government users, a number of foreign countries have expressed an interest in operating satellite systems in the NOAA bands.

[65] See Little LEO Order ¶ 20.

consumer choice, rapid service deployment and lower prices for consumers.[66] This is in the public interest.

36. Accordingly, we adopt a rule granting System 2 a first priority to apply for and use a limited amount of downlink spectrum duly allocated worldwide and domestically to the NVNG MSS service by the ITU, at WRC-97 or a subsequent World Radiocommunication Conference, and by the Commission, respectively (the "Future Spectrum").[67] System 2 will be eligible to apply for and use the first 210 kHz of Future Spectrum plus spectrum sufficient to account for Doppler frequency shift[68] in the Future Spectrum (the "Supplemental Spectrum") in order to fully implement its Little LEO system.[69] System 2's application for and use of the Supplemental Spectrum is subject to the Commission's Rules and policies, such reasonable operating conditions as may be imposed by the Commission, and international spectrum coordination requirements. For so long as System 2 is permitted by the Government of

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[66] Final Analysis indicates that a third competitor could significantly lower price/cost margins. Comments of Final Analysis at Exhibit 1, p. 15. A simple Cournot model indicates that moving from two to four competitors in a market would lower the ratio of price to marginal cost from 2 to 4/3. Hal R. Varian, Intermediate Microeconomics at 453 (NY: W.W. Norton & Co., 1987). We believe that the distinctive characteristics of Little LEO systems and the entry barriers for new Little LEO systems imply a significant risk that having only two Little LEO commercial systems would allow Little LEO operators to exercise market power.

[67] The Commission may adopt rules that are necessary to carry out the provisions of the Communications Act of 1934, as amended, or execute its functions. See 47 U.S.C. §§ 303(r) and 4(i); Notice of Proposed Rulemaking, 11 FCC Rcd 11675, ¶ 23 (1996) (the Commission may adopt rules under Sections 303(r) and 4(i) to carry out its spectrum management obligations); see also Loyola Univ. v. FCC, 670 F.2d 1222, 1226 (D.C. Cir. 1982) (the Commission's discretion is particularly great when the issues involve technical matters and questions about priorities in usage of the radio spectrum).

[68] "Doppler frequency shift" is the apparent change of the transmitted frequency due to the movement of the transmitter and/or receiver of the transmitted frequency. For example, when a transmitting LEO satellite is moving away from the receiver, the frequency of the transmission received is lower than the frequency transmitted by the satellite and higher when a transmitting LEO satellite is approaching the receiver.

[69] Final Analysis, the System 2 designee in the Joint Proposal, proposes operating nine service downlinks as part of its system. See Amendment to Application of Final Analysis, dated February 26, 1996. Final Analysis estimates that it can operate only two of nine proposed service downlinks in the spectrum assigned to System 2 if it is unable to operate in the 400.5517-400.5983 MHz band coordinated with the French system S80-1. See Final Analysis Letter. We estimate that a Little LEO system designed to operate service links at 19.2 kbps will require approximately 30 kHz of emission bandwidth for a service downlink channel. Assuming that Final Analysis would require up to seven additional service downlinks to implement a large Little LEO system this would require use of approximately 210 kHz of Future Spectrum. If Final Analysis is able to utilize the 400.5517-400.5983 MHz band for service downlinks, it estimates that it can operate four of nine service downlinks in the spectrum assigned to System 2. Thus, it would require only an additional 150 kHz of Future Spectrum to implement its proposed system. The amount of Supplemental Spectrum roughly approximates the 325 kHz of spectrum in the NOAA bands that is allocated on a secondary, non-interference basis to the Little LEO service and that is assigned to System 2.

France to operate in the 400.5517-400.5983 MHz band coordinated with the French system S80-1, the Supplemental Spectrum shall be reduced to an amount equivalent to 150 kHz of Future Spectrum plus spectrum sufficient to account for Doppler frequency shift in the Future Spectrum.

37. System 2's priority to apply for and use the Supplemental Spectrum is conditioned on System 2's compliance with the terms and conditions of its second processing round license, including, but not limited to, its system construction, launch and operation milestones, and any modifications thereto, and the Commission's Rules. System 2's priority to apply for and use the Supplemental Spectrum as provided for in this Report and Order shall automatically terminate upon the occurrence of any of the following events: (a) System 2 being permitted to operate in the Supplemental Spectrum; (b) the expiration or revocation of its second processing round license; (c) the discontinuance of use of the spectrum assigned to it under its second processing round license; or (d) the surrender of its second round license to the Commission. The Commission delegates authority to the International Bureau to take the actions necessary to implement System 2's priority to apply for and use the Supplemental Spectrum.

c. System 3

38. A third new Little LEO applicant can operate a system ("System 3") in the 148-148.905 MHz (uplink) and the 137.0725-137.9275 MHz (downlink) spectrum formerly licensed to GE-Starsys. System 3 will be required to be a spread spectrum system because NOAA, an existing authorized user of this band, has taken the position that it will not time-share with more than one Little LEO system[70] (it will be time-sharing the NOAA bands and the NOAA channels with System 2) and a CDMA system is more likely to avoid causing harmful interference to the other authorized users of this frequency band. E-Sat proposes a CDMA system[71] and its six satellite constellation is particularly well-suited to operate in the spectrum assigned to System 3. Moreover, the second round applicants and E-Sat agreed in the Joint Proposal that E-Sat will operate as System 3.[72]

39. System 3's operations in the 148-148.905 MHz uplink band shall be consistent with the agreement GE-Starsys entered into with Orbcomm and the S80-1 system. System 3 will share approximately 355 kHz of spectrum in the 148-148.855 MHz band with System 1, System 2 and Orbcomm. System 3 shall have the use of approximately 500 kHz of

[70] See, infra, ¶ 52.

[71] See Comments of E-Sat at 1. See also E-Sat Letter.

[72] See Joint Proposal at 2.

contiguous spectrum in the 148-148.855 MHz band that will not be shared with System 1, System 2 and Orbcomm for use with the S80-1 system. The 148.855-148.905 MHz band shall be used for feeder links, however, System 1, System 2 and Orbcomm may share this band if System 3 does not use this band for feeder links.

40. System 3 shall operate in the 137.0725-137.9275 MHz downlink band consistent with the coordination agreements GE-Starsys entered into with NOAA, Orbcomm and the S80-1 system. System 3's operation in this band also will be subject to coordination with the Russian METEOR system. Finally, System 3 will share the 137-138 MHz band with System 2.

d. Orbcomm

41. Sufficient spectrum also exists to accommodate modifications to the Orbcomm system applied for in the second processing round. Orbcomm shall operate as a FDMA/TDMA system. The second round applicants and Orbcomm agreed in the Joint Proposal that Orbcomm will operate in the uplink and downlink spectrum set forth below.[73]

42. In the uplink bands, Orbcomm shall share approximately 355 kHz of spectrum in the 148-148.855 MHz band with System 1, System 2 and System 3, subject to coordination with the French S80-1 system. Orbcomm shall preserve approximately 500 kHz of contiguous spectrum in the 148-148.855 MHz band that will not be shared by System 1, System 2 or Orbcomm for use by System 3 and the S80-1 system. Orbcomm may also share the 148.855-148.905 MHz band with System 1 and Orbcomm if System 3 does not use this band for feeder links. Subject to S80-1's use of the 148.905-148.955 MHz band for feeder links, first round licensee Orbcomm shall share the 148.905-149.81 MHz band with System 1 and System 2, provided, that Orbcomm shall have exclusive use of the 149.585-149.635 MHz portion of the band for feeder link use until it relocates its feeder uplink to the 150-150.05 MHz band. Orbcomm and VITA shall share the 149.81-149.90 MHz band as authorized in the first processing round. Orbcomm shall relocate its feeder links to the 150-150.05 MHz band, when System 2 vacates this band. Upon such relocation, Orbcomm shall cease its use of the 149.585-149.635 MHz band for feeder links and System 1, System 2 and Orbcomm shall share this portion of the band for service links. Orbcomm's relocation of its feeder links to the 150-150.05 MHz band shall be subject to the conditions imposed on System 2 in connection with its coordination of this spectrum with the Russian RNSS system.

43. Orbcomm shall share the 137-138 MHz downlink frequency band with System 3. Specifically, Orbcomm shall operate in the 137.175-137.3275 MHz, 137.4225-137.4725 MHz, 137.535-137.585 MHz, 137.650-137.750 MHz and 137.7875-137.8125 MHz portions of the frequency band, subject to the Commission's approval of Orbcomm's pending modification request of its first round license. Orbcomm shall time-share the 137.275-137.325 MHz band,

[73] Id. at 7.

subject to coordination with the Russian METEOR system. Orbcomm's use of the spectrum in the 137-138 MHz band shall also be coordinated with NOAA and System 2 with respect to sharing adjacent channels.

e. VITA

44. We also find that sufficient spectrum exists to accommodate VITA's second round modification request. VITA shall also operate as a FDMA/TDMA system. The second round applicants and VITA agreed in the Joint Proposal that VITA will operate in the uplink and downlink spectrum discussed below.[74]

45. VITA shall continue to share the 149.81-149.90 MHz uplink frequency band with Orbcomm as authorized in the first processing round.

46. In the downlink spectrum, VITA is currently authorized to operate one satellite in the 400.505-400.5517 MHz band and will time-share this band with System 2. VITA shall operate the satellite applied for in the second processing round in the 400.5983-400.645 MHz band, if authorized by the Commission, on a time-shared basis with System 2. Upon System 2's surrender of its authorization, notification to the Commission that it is discontinuing its use of these bands or the Commission's termination of System 2's authorization, System 1 may operate in the 400.505-400.5517 MHz and 400.5983-400.645 MHz bands, subject to the same conditions imposed upon System 2's operations in these bands by the Commission or in connection with time-sharing with VITA. VITA shall notify the Commission within 30 days of discontinuing its use of this band.

2. Satellite System Requirements

47. In order for multiple Little LEO systems to share the WARC-92 spectrum available for use by second processing round applicants, we must consider service link and feeder link spectrum requirements[75] and the transmission techniques to be employed by a Little LEO system for transmissions between user terminals, gateways and LEO satellites in the proposed systems.

48. In assigning spectrum to second processing round applicants, we must be cognizant of the limitations on use of the spectrum for service link and feeder link transmissions. Service links transmit data messages between a user terminal and a satellite. It is possible for the proposed Little LEO systems to share their service link spectrum with other Little LEO systems because such transmissions are not continuous and are less likely to be affected by

[74] Id. at 8.

[75] A user terminal communicates with a LEO satellite via a low power service link. A gateway station communicates with a LEO satellite via a high power feeder link.

sharing. Feeder links aggregate service link data messages and transmit them between a gateway and a satellite. Satellite systems generally require continuous access to their feeder link spectrum. This is true for most of the proposed Little LEO systems. Continuous feeder link transmissions are required between a system's gateways and satellites in order to provide for the prompt relay of all service link messages to system users. Consequently, sharing of feeder link spectrum among multiple Little LEO systems can be problematic.[76] We believe that each Little LEO system deploying multiple satellites will require at least 50 kHz of feeder link spectrum for uplink and downlink communications[77] in order to accommodate the high-speed data transmissions necessary for gateway-satellite feeder link communications and to compensate for the effects of Doppler frequency shift and other spectrum propagation characteristics.

49. In finding ways to share the WARC-92 spectrum among multiple Little LEO systems on an interference-free basis, we must also consider the transmission technique used by a satellite system to communicate with its user terminals. Three transmission techniques can be used by a satellite system to communicate with multiple users within a single system and to avoid causing harmful interference to the user terminals of multiple systems: frequency division multiple access ("FDMA"), time division multiple access ("TDMA") and code division multiple access ("CDMA"). FDMA and TDMA systems operate in channels within a frequency band. FDMA systems communicate with multiple user terminals by transmitting simultaneously in different channels in the same frequency band. TDMA systems communicate with multiple user terminals by transmitting in alternating time slots within a single channel in a frequency band. CDMA systems communicate simultaneously with multiple user terminals by transmitting coded signals spread across an entire frequency band or sub-band, not in channels like an FDMA or TDMA system. The coded signals ensure that each signal is received by its proper destination.

50. Because the WARC-92 spectrum allocated to the Little LEO service is limited, a Little LEO system must find ways to share spectrum for service and feeder links and avoid causing harmful interference to other authorized users. Frequency sharing techniques, such as dynamic channel activity assignment ("DCAAS"), time-sharing and frequency hopping, allow multiple satellite systems to share the same frequency bands. DCAAS allows an FDMA or TDMA system to scan the channels in a frequency band and assign transmissions to channels that are not currently in use by other users of the band. Time-sharing allows multiple satellite systems to use the same frequency band at different times and thereby avoid interfering with other satellite systems or authorized users operating in the band. Frequency hopping enables a Little LEO satellite to switch or "hop" to an alternative sub-band within a frequency band when the sub-band it is using becomes unavailable. A Little LEO system employing a

[76] See Comments of Final Analysis at 17 (citing the Commission's Little LEO Notice, 8 FCC Rcd 6330, ¶ 12); See also Negotiated Rulemaking Report ¶ 12.

[77] See Negotiated Rulemaking Report ¶ 12.

combination of these sharing techniques can avoid interference to other systems and greatly increase the system's availability to its users.

3. Analysis of the Plan

51. The spectrum sharing plan we adopt accommodates the entry of three new Little LEO system applicants: LEO One, Final Analysis and E-Sat. In addition, it accommodates the system expansion requests of existing Little LEO licensees, Orbcomm and VITA.

52. Our Notice proposed up to three systems operating in the available spectrum.[78] However, in light of GE-Starsys's return of its first round license, the withdrawal of other second round applicants, and the agreement of the remaining applicants upon a spectrum sharing plan, the five-system spectrum sharing plan proposed by the second round applicants that we adopt in this Report and Order is technically feasible and constitutes a more efficient use of the available WARC-92 spectrum than does our original three-system proposal. Moreover, it respects the positions taken by existing United States government satellite systems against time-sharing their respective downlink spectrum with more than one Little LEO system.[79] Finally, the five-system spectrum sharing plan, rather than our proposed three-system plan, is more likely to serve our goals of promoting competition in the provision of Little LEO services and fostering the delivery of Little LEO services to market as quickly as possible at reasonable prices to consumers.

53. In developing a spectrum sharing plan, we evaluated a number of factors. First, we considered the spectrum sharing plan mutually agreed to by the second round applicants

[78] See Notice ¶ 42.

[79] See Letter dated May 22, 1997, from Richard D. Parlow, Associate Administrator, Spectrum Management, United States Department of Commerce National Telecommunications and Information Administration, to Peter Cowhey, Chief, International Bureau, Federal Communications Commission (the "Second NTIA Letter") enclosing correspondence received from the Department of the Air Force and the United States Department of Commerce National Telecommunications and Information Administration Interdepartment Radio Advisory Committee; Letter dated May 7, 1997, from Richard D. Parlow, Associate Administrator, Spectrum Management, United States Department of Commerce National Telecommunications and Information Administration, to Peter Cowhey, Chief, International Bureau, Federal Communications Commission, Ref. IB Docket No. 96-220 (the "First NTIA Letter" and the Second NTIA Letter collectively, the "NTIA Letters"), enclosing correspondence received from the Department of the Air Force and the National Oceanic and Atmospheric Administration; Letter dated April 21, 1997, from Frank M. Holderness, Army Representative, Bruce Swearingen, Navy Representative, Nelson Pollack, Air Force Representative, and Richard Barth, Commerce Representative, Office of Frequency Management, United States Department of Commerce National Oceanic and Atmospheric Administration, to Norbert Schroeder, Acting Chairman, IRAC, United States Department of Commerce National Telecommunications and Information Administration. See also, infra, ¶¶ 100, 106.

that was filed with the Commission.[80] Second, we considered whether operating additional systems in the bands would cause unacceptable interference[81] to or negatively impact the capacity[82] of existing systems, including United States government systems. Third, we sought to ensure that New Little LEO Applicants were given access to an adequate amount of spectrum in order to implement viable systems. We also sought to accommodate the additional spectrum requests of existing Little LEO licensees, if possible. Based on these assessments, we determined which portions of the uplink and downlink bands could best accommodate service links and feeder links for new systems and existing Little LEO licensees.

a. Uplink Band (148-150.05 MHz)

54. The second round applicants will uplink in a number of sub-bands in the 148-150.05 MHz band. System 1, System 2 and Orbcomm will operate their service links in the 148-148.25 MHz and 148.75-148.855 MHz sub-bands to be used by System 3 and the S80-1 system. System 1 and System 2 will also uplink in the 148.905-149.81 MHz sub-band used by first round licensee, Orbcomm. In addition, Orbcomm and VITA will share the 149.81-149.90 MHz uplink. Initially, System 1 and System 2 will operate their feeder links in the 149.95-150 MHz and 150-150.05 MHz bands, respectively, and Orbcomm will operate its feeder links in the 149.585-149.635 MHz band.

55. Second processing round licensees must coordinate their systems and avoid causing harmful interference into numerous satellite and terrestrial systems in the 148-150.05 MHz band using the rules established in the Negotiated Rulemaking Report. Orbcomm, VITA, S80-1, and the Russian system, TSYKADA, are using or will use the 148-150.05 MHz uplink band. In the Negotiated Rulemaking Report, first round licensees agreed to restrict VITA's operations to the 149.81-149.9 MHz band, Orbcomm's operations to the 148.905-149.9 MHz band, and GE-Starsys' operations to the 148-148.905 MHz band.[83] The agreement also reserved the 148.855-148.905 MHz band for the GE-Starsys feeder uplinks and the 149.585-149.635 MHz band for Orbcomm's feeder uplinks. Orbcomm will continue to have exclusive use of the 50 kHz of spectrum at 149.585-149.635 MHz until it relocates its feeder uplinks to the 150-150.05 MHz band. In addition, as a result of recent international coordination

[80] See Joint Proposal.

[81] Interference generally occurs when transmissions from one system disrupt the ability of another system's satellite and earth terminals to receive transmissions.

[82] The capacity of a system can generally be defined as the total number of subscribers a system can serve when at maximum operation. Capacity can be diminished by reducing the amount of spectrum available for use by a system. The amount of spectrum available for use by a system may decrease if other systems are using the same spectrum.

[83] See Negotiated Rulemaking Report.

discussions with other administrations, S80-1 is expected to operate its service links in the 148-148.905 MHz band and feeder links in the 149.9-149.95 MHz band.[84] Consequently, System 3 may be required to share its 50 kHz of feeder link spectrum at 148.855-148.905 MHz with S80-1. The Russian system, TSYKADA is currently using the 149.9-150.05 MHz band to provide RNSS service and the operations of System 1 and System 2 in these frequency bands will be required to be coordinated with TSYKADA.

56. System 1, System 2 and Orbcomm will operate in the 148-148.905 MHz sub-band, where System 3 will also operate, and in the 148.905-149.81 MHz sub-band where Orbcomm is currently authorized to operate, subject to S80-1's use of the 148.905-148.955 MHz band for feeder uplinks. This arrangement will result in the most efficient use of spectrum and avoid causing harmful interference into System 3, if System 1, System 2 and Orbcomm's system use DCAAS/FDMA transmission techniques. It is our view that the foregoing spectrum and system assignments represent the most technically feasible use of spectrum in the 148-150.05 MHz uplink band.

i. Sharing with System 3 (148-148.25 MHz and 148.75-148.855 MHz bands)

57. Our analysis demonstrates that operation of System 1, System 2 and Orbcomm in the 148-148.25 MHz and 148.75-148.855 MHz bands will not significantly affect the system capacity or cause harmful interference to System 3. E-Sat, the System 3 designee, and the other second round applicants have agreed to this arrangement.[85] GE-Starsys, a CDMA system, was authorized to operate in the 148-148.905 MHz band and recently returned its authorization to the Commission. GE-Starsys initiated but did not complete coordination of its CDMA system with the S80-1 system in this band. A CDMA system similar and smaller in size to GE-Starsys's CDMA system should be able to operate as System 3 without receiving unacceptable interference from System 1, System 2 or Orbcomm.

58. CDMA systems are most vulnerable to interference at their center frequencies. Therefore, we assign System 1, System 2 and Orbcomm use of the 148-148.25 MHz and 148.75-148.855 MHz frequency bands, which are the least vulnerable portions of the 148-148.855 MHz band. The center frequencies in the 148.25-148.75 MHz band will be maintained for use by only System 3 and S80-1. Relating to this point, the second round applicants request, and we agree, that approximately 500 kHz of contiguous spectrum shall be

[84] In the event that France is unable to successfully coordinate its S80-1 feeder link operations in the 149.9-149.95 MHz band with the Russian RNSS system, the United States and France, at an April 1996 bi-lateral meeting, agreed that the 148.905-148.955 MHz band would be used by France for their feeder link operations. Since feeder link operations for a Little LEO system ordinarily require exclusive spectrum, System land System 2 would not be able to operate in the 148.905-148.955 MHz band. France will notify the United States if and when this occurs. The Commission will notify the affected licensee(s) accordingly.

[85] See Joint Proposal at 6.